A Guide to Processing Fin-Rays for Age Determination

D. Little, S.E. MacLellan, and K. Charles

Fisheries and Oceans Canada
Sclerochronology Laboratory, Pacific Region
Pacific Biological Station
Nanaimo, British Columbia
V9T 6N7

2012

Canadian Technical Report of Fisheries and Aquatic Sciences 3002

Fisheries and Oceans Pêches et Océans

Canada

Canadian Technical Report of Fisheries and Aquatic Sciences

Technical reports contain scientific and technical information that contributes to existing knowledge but which is not normally appropriate for primary literature. Technical reports are directed primarily toward a worldwide audience and have an international distribution. No restriction is placed on subject matter and the series reflects the broad interests and policies of Fisheries and Oceans Canada, namely, fisheries and aquatic sciences.

Technical reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in the data base *Aquatic Sciences and Fisheries Abstracts*.

Technical reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page.

Numbers 1-456 in this series were issued as Technical Reports of the Fisheries Research Board of Canada. Numbers 457-714 were issued as Department of the Environment, Fisheries and Marine Service, Research and Development Directorate Technical Reports. Numbers 715-924 were issued as Department of Fisheries and Environment, Fisheries and Marine Service Technical Reports. The current series name was changed with report number 925.

Rapport technique canadien des sciences halieutiques et aquatiques

Les rapports techniques contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui ne sont pas normalement appropriés pour la publication dans un journal scientifique. Les rapports techniques sont destinés essentiellement à un public international et ils sont distribués à cet échelon. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques de Pêches et Océans Canada, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports techniques peuvent être cités comme des publications à part entière. Le titre exact figure au-dessus du résumé de chaque rapport. Les rapports techniques sont résumés dans la base de données *Résumés des sciences aquatiques et halieutiques*.

Les rapports techniques sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre.

Les numéros 1 à 456 de cette série ont été publiés à titre de Rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457 à 714 sont parus à titre de Rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715 à 924 ont été publiés à titre de Rapports techniques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 925

Canadian Technical Report of
Fisheries and Aquatic Sciences 3002

2012

A GUIDE TO PROCESSING FIN-RAYS FOR AGE DETERMINATION

by

D. Little, S.E. MacLellan, and K. Charles

Fisheries and Oceans Canada
Sclerochronology Laboratory, Pacific Region
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, BC
V9T 6N7

E-mail: shayne.maclellan@dfo-mpo.gc.ca

© Her Majesty the Queen in Right of Canada, 2012
Cat. No. Fs 97-6/3002E ISSN 0706-6457

Correct citation for this publication:

Little, D., MacLellan, S.E., and Charles, K. 2012. A guide to processing fin-rays for age determination. Can. Tech. Rep. Fish. Aquat. Sci. 3002: iv + 19 p.

TABLE OF CONTENTS

TABLE OF CONTENTS iii
ABSTRACT iv
RÉSUMÉ iv
1.0 INTRODUCTION 1
2.0 FIN PREPARATION METHODS 1
2.1. TRIMMING AND DRYING FINS 1
2.1.1. Equipment and materials 3
2.1.2. Procedure 4
2.1.2.1. Preparing frozen fins 4
2.1.2.2. Preparing dried fins 4
2.2. MOUNTING FINS IN EPOXY 7
2.2.1. Equipment and materials 8
2.2.2. Procedure 8
2.2.2.1. Epoxy preparation for large fins 8
2.2.2.2. Epoxy preparation for small or damaged fins 9
2.3. SECTIONING FINS 10
2.3.1. Equipment and materials 10
2.3.2. Procedure 11
2.3.2.1. Preparation of glass slides 11
2.3.2.2. Sectioning epoxied fins 11
2.3.2.3. Sectioning non-epoxied fins 15
2.4. MOUNTING FIN SECTIONS ONTO SLIDES 15
2.4.1. Equipment and materials 15
2.4.2. Procedure 15
2.5. STORAGE OF FIN SECTION SLIDES 16
2.5.1. Equipment and materials 16
2.5.2. Procedure 16
2.6. SECTIONING MACHINE MAINTENANCE 17
ACKNOWLEGEMENTS 17
GLOSSARY 18
REFERENCES 19

Abstract

Little, D., MacLellan, S.E., and Charles, K. 2012. A guide to processing fin-rays for age determination. Can. Tech. Rep. Fish. Aquat. Sci. 3002: iv + 19 p.

This manual describes the methodology, techniques, terminology, materials and equipment used by the Sclerochronology Lab Program at the Pacific Biological Station at Nanaimo, B.C. to prepare fish fins for age determination. Fin preparation is labour intensive and requires strict attention to detail. This ensures that technical preparation errors do not affect the clarity of annual growth patterns on fin sections. Poor quality sections impact the quality of age data produced which in turn affects stock assessments and ensuing management decisions for important commercial fisheries. The manual sets out procedures which have evolved, with testing where appropriate, to be the current operational standard for the DFO Pacific Region. A further purpose is to provide information to other agencies and individuals wishing to employ established fin-ray methods for fish age determination.

Résumé

Little, D., MacLellan, S.E., and Charles, K. 2012. A guide to processing fin-rays for age determination. Can. Tech. Rep. Fish. Aquat. Sci. 3002: iv+ 19 p.

Le présent manuel décrit la méthodologie, les techniques, la terminologie, les matériaux et l'équipement utilisés dans le cadre du programme Laboratoire sclérochronologique à la station biologique du Pacifique de Nanaimo, en Colombie-Britannique, afin de préparer les nageoires de poissons en vue de la détermination de l'âge. La préparation des nageoires est très exigeante et requiert une grande minutie. Il s'agit d'éviter que des erreurs de préparation technique n'affectent la clarté des rayons de croissance annuelle sur les sections de nageoire. Des sections de piètre qualité nuisent à la qualité des données sur l'âge obtenues, ce qui influe sur les évaluations des stocks et sur les décisions connexes qui touchent les pêches commerciales. Le manuel explique les procédures ainsi que les tests qui constituent la norme opérationnelle dans la région du Pacifique du MPO. Le manuel vise également à fournir de l'information à d'autres organismes et personnes qui souhaitent utiliser des méthodes éprouvées de détermination de l'âge des poissons par l'étude des rayons des nageoires.

1.0 INTRODUCTION

The Fisheries and Oceans Canada (DFO) Sclerochronology Laboratory (SCL) program at the Pacific Biological Station receives substantial annual requests to determine the age of a wide range of marine fish species for the Pacific Region. The age data produced is employed by scientists and biologists for stock assessment, fishery management and research purposes. Several bony structures, including scales, otoliths and fins are collected by various DFO research programs to determine the age of selected finfish species (Chilton and Beamish 1982). Scales are usually collected for shorter-lived species while otoliths are most commonly used for determining the ages of those that are longer-lived. Fins are collected to assess age when the otoliths or scales do not present a clear and consistent growth pattern. Fins most often are used to age species of short to moderately long-lived fish of around 20 years or less (Beamish and Chilton 1977, Mills and Beamish 1980). The SCL uses the fin method to determine the age of lingcod (*Ophiodon elongatus*) for which the method was validated by McFarlane and King (2001), pollock (*Theragra chalcogramma*) (Beamish 1981), Pacific cod (*Gadus macrocephalus*) (Beamish 1981) and some spawning Pacific salmon species (Chilton and Bilton 1986).

Processing fins for age determination is labour intensive when compared to production methods used by the SCL for scales and otoliths. A fair amount of lead time is required to section fin samples to meet age data deadlines. Generally, it takes around one to two weeks for fins to dry. Then it takes another five days per 100 fins to trim, epoxy, section and mount specimens onto slides. Preparation time increases if the sample condition is substandard or if the fins are very oily or large. Poor quality fin sections ultimately impact the accuracy of age data. The primary purpose of this manual is to promote consistent fin preparation and sectioning methodology and to provide detailed instructions for training technicians in the SCL. Specific materials, equipment and product names referred to in this manual, are not an endorsement by Fisheries and Oceans Canada. Similar equipment and products can be substituted.

2.0 FIN PREPARATION METHODS

2.1. TRIMMING AND DRYING FINS

The main goal in trimming and drying fins is to ensure that the dried fin results in a product with flat parallel rays that will facilitate sectioning and result in thin cross-sections with good growth pattern clarity. Fins from salmon (and some other species) are usually sent to the SCL frozen in numbered coin envelopes or plastic bags. They often require additional trimming to remove excess flesh and cartilage. Fins from other species such as lingcod, pollock and Pacific cod are usually sent to the SCL already dried and partially trimmed.

It is important to note that juvenile annual years of growth form in the centre of the fin base. Imagine the formation of fin annual zones simplistically as a stack of hollow cones which gradually gets taller as bigger cones are added on top of previous annual cones. The first year of growth, especially freshwater growth on salmon fins, may only be visible on the first few cross-sections cut immediately

above the base. Extreme care must be taken to avoid removing any part of the fin base that might include the first annual growth zone when collecting or trimming the fin. Ferreira et al. (1999) provides information and images showing how fin tissues (bones and cartilage) are arranged, which helps to illustrate what and where to trim. Figure 1 illustrates the basics of fin components and orientation on the fish body. Each fin-ray is composed of two bony elements, both of which exhibit annual growth zones. In cross-section, the shape of elements may or may not be mirror images of each.

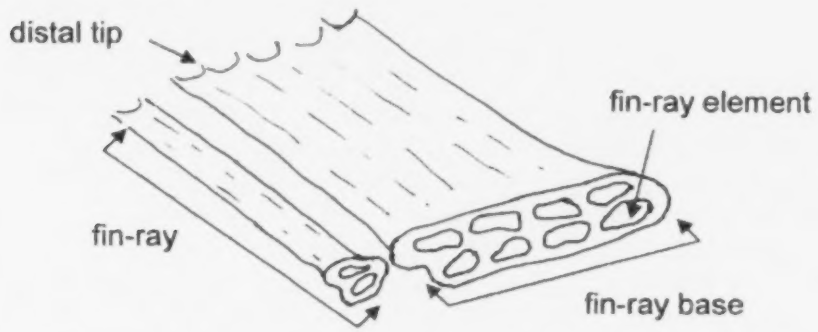


Figure 1. Fin components and identification of the distal tip and the fin base that is cut away from the fish's body.

Trimming fins down to size is often necessary to prepare them for sectioning. Over-large fins can affect the efficiency of sectioning and therefore the quality of sections. Many fins contain more rays than are needed for age determination. Trimming reduces fin 'width' down to specific preferred rays that have previously been identified as best for age determination. A minimum of three rays are needed to estimate age. The ideal width of a trimmed fin is around 2.5cm which is the most efficient 'working' depth of the SCL's sectioning machine saw blade. When whole fins are ≤2.5cm the SCL sections all of the fin-rays. Table 1 lists the species for which the SCL prepares fins for age determination, and preferred fins and rays along with recommended section thicknesses. If no preferred rays are indicated the whole fin may be sectioned or the bigger rays that present the "largest" growth pattern for interpretation are usually assessed.

Fins are best air dried before applying epoxy. Forced heat may cause fin-ray bones to crack subsequently interfering with the clarity of the growth pattern affecting the accuracy of age data. Size and moisture/oil content of connective tissues around the bones determines how long it takes for fins to air dry. It can vary from a few days to two or more weeks. For instance, it can take large oily salmon fins several weeks to dry completely. Fins are deemed dry enough to be epoxied when they feel dry and are rigid and hard to the touch. In some cases, they may still remain a bit oily regardless of any amount of time drying.

Table 1. Preferred fins, fin-rays and section thickness measurements for species aged by the SCL. The last column contains the number of units to turn the Bronwill® cross-feed wheel to produce a section of the desired thicknesses.

Species	Preferred fin & fin-rays	Section thickness measurements (mm) +/- 0.25mm	Units on Bronwill® cross-feed handle
albacore tuna	dorsal/anal	1.5 – 2.0	60 - 80
bulltrout	dorsal/pectoral	1.5 – 1.75	60 - 70
burbot	pectoral/pelvic	2.25 – 2.75	90 - 110
catfish	dorsal/pectoral	1.0 – 1.25	40 - 50
chinook (adults)	pectoral, 1st - 8th rays dorsal, 2nd - 5th rays	1.0 - 1.5 1.0 – 2.0	40 - 60 40 - 80
chum	pectoral	1.3 – 1.5	45 - 60
coastrange sculpin	pectoral/pelvic	1.0 – 1.25	40 – 50
coho (adult)	dorsal/pectoral	1.0– 1.5	40 – 60
coho (juvenile)	dorsal/pectoral	0.75 -1.25	30 - 50
dolly varden	pectoral/pectoral	1.0 – 1.25	40 - 50
lake whitefish	pectoral pelvic	1.25 – 1.75 1.0 – 1.25	50 - 70 40 - 50
largescale sucker	pectoral/pelvic/dorsal	1.0 – 1.25	40 - 50
lingcod	2nd dorsal, 4th - 8th rays	2.25 - 3.0	90 - 120
mountain whitefish	pectoral pelvic	1.0 – 1.25 1.25 – 1.75	40 – 50 50 – 70
northern pike	pectoral/pelvic	1.0 – 1.25	40- 50
northern pikeminnow	pectoral/pelvic	1.0 – 1.25	40 - 50
Pacific cod	2nd dorsal 2nd – 5th or 6th	1.5 – 2.0	60 - 80
peamouth chub	pectoral/pelvic	1.0 – 1.25	40 - 50
pollock	Pectoral,1st - 8th rays	1.25 - 1.75	50 - 70
prickly sculpin	pectoral/pelvic	1.0 – 1.25	40 – 50
rainbow trout	pectoral/pelvic	0.75 – 1.0	30 - 40
sockeye juveniles	dorsal/pectoral	1.0 – 1.5	40 - 60
sturgeon	pectoral (1st ray)	1.25 - 1.5	50 - 60
walleye	pectoral/pelvic	1.25 – 1.50	50 - 60
white sturgeon	pectoral/pelvic	1.0 – 1.25	40 - 50

2.1.1. Equipment and materials

Various types of scissors (Fig. 2) or a fin punch (Fig. 3) may be used to trim fins of varying sizes. Use of scissors requires some trained skill to ensure proper selection of the desired fin-rays while avoiding cutting away critical bone needed for age determination. The fin punch is a tool originally developed for use in the field to collect salmon pectoral fin samples. When using the punch it is important to place it close to the fin base which can be difficult. It results in a fin punch that does not require further trimming. Dorsal fins are usually too large with more robust fin-rays for the punch to work effectively. Despite these drawbacks, this is a quick, easy method to isolate the preferred rays. The SCL mainly uses scissors to trim lingcod, Pacific cod and pollock fins. Coin envelopes are employed to identify and store fins, and to maintain fin shape while drying.

- Heavy paper coin envelopes - 32lb kraft, ungummed, 7.5 x 11.5cm
- Dark pencil
- Universal scissors, dissecting scissors or fin punch
- Drying rack
- Divided box

2.1.2. Procedure

2.1.2.1. Preparing frozen fins:

1. Label envelopes (Fig. 4) with appropriate sample information using a dark pencil. The SCL labels the first fin envelope in a series with all sample information: fish number, fin type, species, area and date caught, and vessel name if applicable. Subsequent envelopes require only an abbreviated species name and fish number. Example: LC - 2 (LC = lingcod, fish #2).
2. Thaw fins and trim before they dry out.
3. Refer to Table1 to identify the preferred fin-rays for species aged by the SCL.
4. Use large (Universal) scissors (Fig. 2) to cut between fin-rays and isolate the group of preferred rays (Fig. 5). Dissecting scissors or a fin punch (Fig. 3) can be used for small fins.
5. Trim excess flesh from the base of preferred rays (Fig. 6) and carefully remove cartilage from the fin base (Fig. 7). Avoid cutting off fin-ray bases.
6. Fold in the flap of the labelled envelope. Insert the trimmed fin, distal end first (Fig. 1), leaving the fin base slightly extended (1.0-1.5cm) beyond the envelope opening. Spread all rays straight, flat and parallel within the envelope (Fig. 8).
7. Place the envelope with fin into slots on the drying rack (Fig. 9). Leave about 2cm between envelopes to provide good air circulation for thorough drying. Discard unused portions of the fin or replace in envelopes for future use.
8. Once dry, place fins numerically in one side of a divided box (Fig. 10). During the drying process the fins adhere to the envelopes. Each must be detached from its envelope and returned to it in preparation for the next step which is to epoxy. Sometimes this process rips the envelopes to the point where it is necessary to replace them. In this case, copy all pertinent sample and/or fin information to the new envelope.

2.1.2.2. Preparing dried fins:

The SCL also receives fins in labelled envelopes that have already been partially trimmed and dried by field crew. If necessary, separate the preferred fin-rays and trim as outlined above (steps 3-5). Straighten any twisted or folded fins by cutting through the flesh between fin-rays. Epoxy will be used to maintain the orientation (flat and parallel) and stability of individual rays in the next steps.

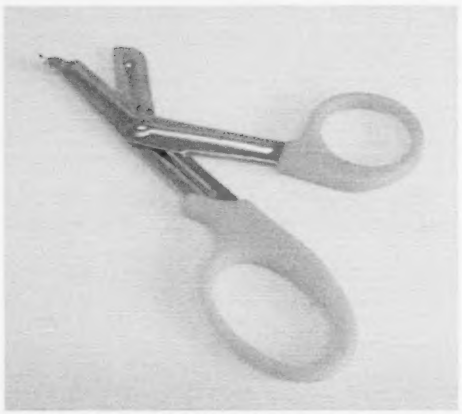


Figure 2. Universal scissors are sturdy, easily able to cut through soft fin tissues.

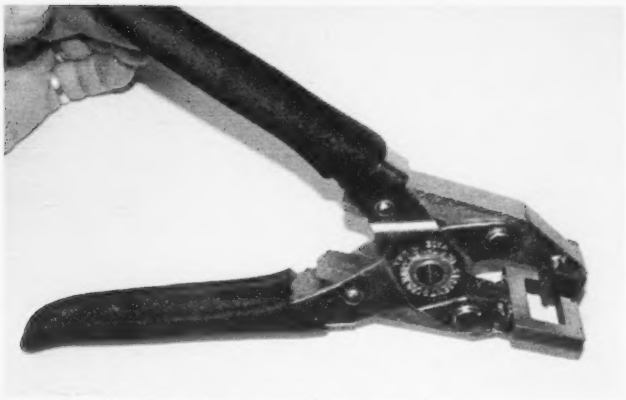


Figure 3. The fin punch is used to cut the preferred rays from smaller fins, e.g. pectorals.

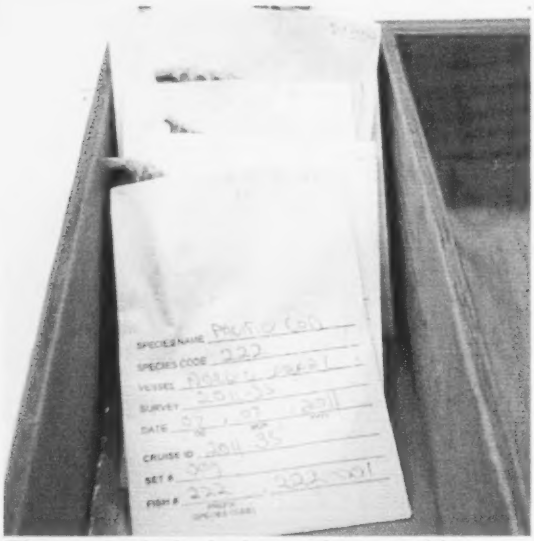


Figure 4. Labeled envelopes with pertinent sample and fish information on the first one and fish ID number only on the rest.

Figure 5. Chinook dorsal fin trimmed to excise the preferred 2nd – 5th fin-rays (arrows) resulting in a width that can be efficiently cut by the saw blade. The first and remaining rays may be restored in the envelope.

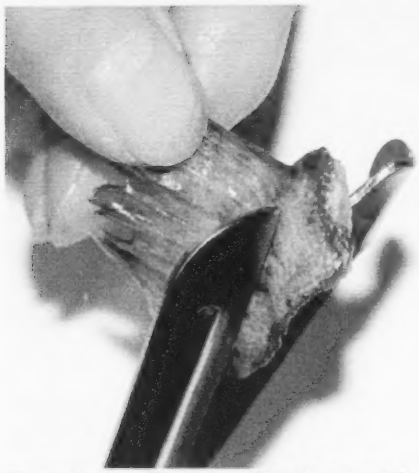


Figure 6. Excess flesh must be trimmed from around the fin base area.

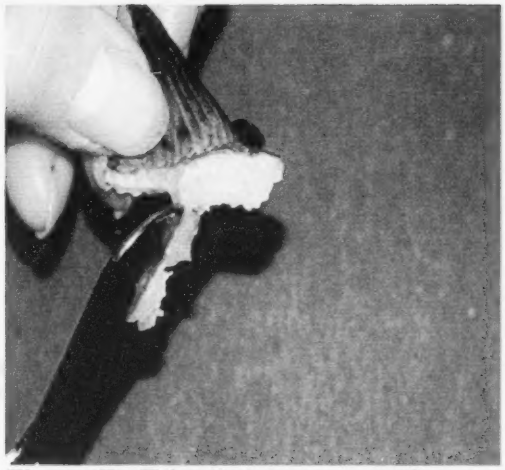
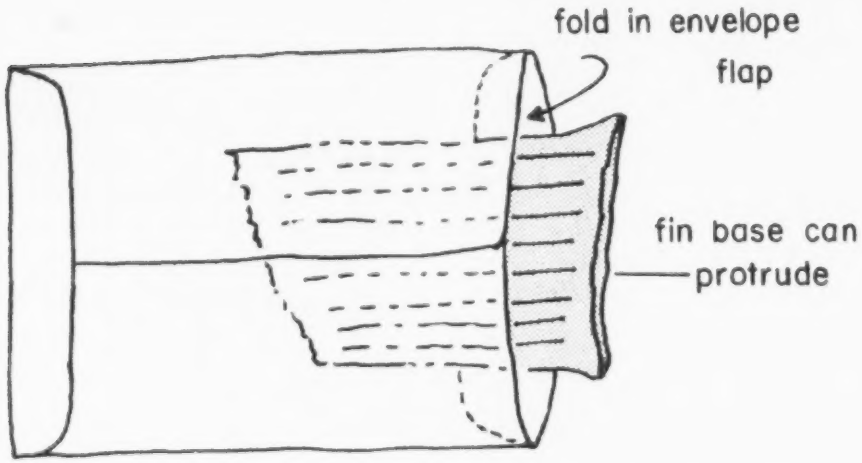


Figure 7. Trim the excess cartilage from the bottom of the fin base.



MacLellan (2004)

Figure 8. Place the fin in the envelope with rays spread apart and parallel and a portion of the base sticking out the opening.

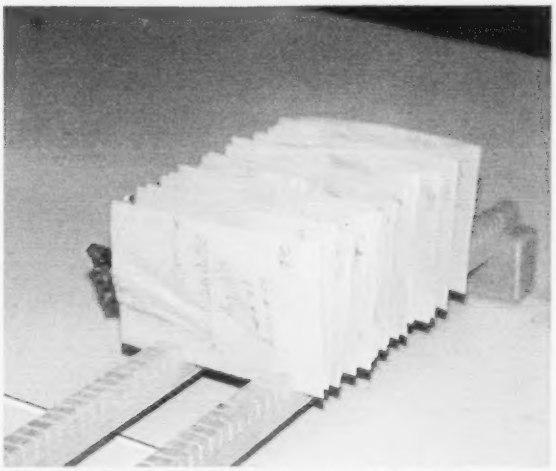


Figure 9. Drying rack used to hold envelopes with trimmed fins for air drying.

Figure 10. Divided box used to hold and organize dried fins envelopes.

2.2. MOUNTING FINS IN EPOXY

Once fins are properly trimmed and dried the next step is to epoxy them. Large, dried fins are coated with a thin coat of epoxy to enhance rigidity and make them waterproof. Water is used to cool the SCL sectioning machine saw blade. The epoxy prevents the fin tissues from softening, collapsing or bending during sectioning which could affect the clarity of the annual growth pattern on the sections. Small, short or broken fins or fins where the rays are separated are placed in a bed of epoxy and/or given an epoxy 'tail' to increase support, length and/or to join separated rays.

Epoxy products vary in viscosity and curing times. For fin preparation, curing time should be relatively slow to allow mixing large quantities for high volume work. The cured epoxy needs to be transparent enough to provide good visibility of the fin-rays for exact sectioning. The ratio of resin and hardener is critical for optimal curing and varies between products; it is essential to follow specific manufacturer's directions. On a health and safety note, epoxy ingredients are caustic and release toxic fumes until cured, therefore all mixing and application must take place in a fume hood and appropriate personal protection equipment worn.

Some species, such as lingcod, have thin rigid fin-rays strong enough to be sectioned without a coat of epoxy. The size and condition of the fin determines whether or not epoxy is needed. Removing the epoxy step reduces material costs, processing time and health concerns making it an attractive method. There is, however, a negative aspect which must be considered. Water cannot be used when sectioning non-epoxied fins. It would soften the connective tissue and rigidity would be reduced for sectioning. Dry sectioning does produce a health risk where fine dust residue is released directly into the air. This means that in addition to a highly efficient exhaust system, the operator needs to wear an approved dust mask designed to filter fine particulates. Currently, due to this health concern, the SCL does not use this method. When water is used to cool

the saw blade the dust produced binds with it and then either falls into the tray or is extracted by the existing grade exhaust system.

2.2.1. Equipment and Materials

- epoxy resin and hardener (e.g. Hysol® Epoxy A&B 0151 or G-2 Epoxy resin and hardener)
- divided box
- large trays
- disposable waxed paper (e.g. Parafilm®)
- disposable container or board
- disposable applicator sticks (e.g. Popsicle sticks or tongue depressors)
- spoon, spatula and disposable measuring cup
- paper towel
- replacement fin envelopes
- health & safety: fume hood
- personal protection equipment: lab coat, disposable latex or nitrile gloves

2.2.2. Procedure

2.2.2.1. Epoxy preparation for large fins:

1. Cover a large tray with Parafilm® to prevent epoxied fins sticking to the tray (Fig. 11).
2. Label with sample information and fin numbers and place in the fume hood. Always use a fume hood to remove toxic fumes when mixing and applying epoxy.
3. Matching each fin to its labelled square, place on the tray with the distal tip (Fig. 1) on left towards the top of the board. In this position, excess epoxy will run under the fin and leave the upper side of the rays visible for sectioning.
4. Leave a small space between each fin and continue to fill the board. If an epoxy tail is needed (instructions below), allow enough space for a total length of 7cm.
5. Use separate utensils (spoons/spatulas) to transfer resin and hardener into a disposal measuring cup to avoid contamination. Clean utensils with paper towel and leave in fume hood.
6. Mix with Popsicle stick, stirring well for 2-3 minutes. Hysol® Epoxy should become opaque while G-2 Epoxy will turn an even honey colour.
7. Pick up fin by the distal tip and spread a thin coat of epoxy to cover the fin base and all pockets and hollows on both sides of the fin ensuring all surfaces are smooth.
8. If the fin is flexible apply a thicker coat of epoxy (~3mm) on the underside of the fin for additional support.
9. Replace fin on the board in its identified space and correct orientation.
10. Continue as above for all remaining fins.

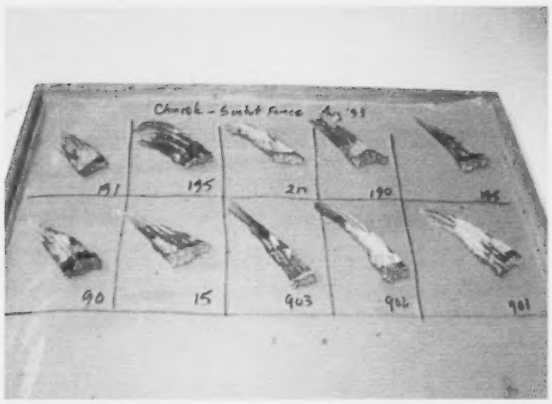


Figure 11. Parafilm® attached to tray with labelled fins.

2.2.2.2. Epoxy preparation for small or damaged fins:

Fins need to extend a minimum of 2.0-4.0cm beyond the sectioning machine chuck to provide room to cut the required number of sections and keep the saw blade and flange from colliding with the chuck. A bed or tail of epoxy can be used to add length/width to small, short or damaged fins. An epoxy bed can also be used to insert individual separated rays to provide solid support and alignment for sectioning. Highly viscous (e.g. Hysol®) epoxy resin is needed for this as it will retain the required shape to embed the fins/fin-rays.

1. Follow steps 1 – 7 above
2. Prepare a bed of epoxy on the board measuring about 5.0 – 6.0cm long, 2.5cm wide and 0.5cm thick (Fig. 12).
3. Embed the separated rays within the bed of epoxy (Fig. 13) or place the small already epoxied fin onto the epoxy tail with the distal end to the left (Fig. 14).
4. Spread a thin coat of epoxy over the separated rays or from the surface of the epoxy tail over the distal/dorsal end of the fin-rays to make a smooth join between fin and epoxy tail/bed. During sectioning, this smooth surface will ensure the fin sits in the chuck perpendicular to the blade.
5. Leave unused epoxy in the fume hood until cured then place in garbage.
6. Allow epoxied fins one to three days to cure before returning them to their respective envelopes in the divided box.

Figure 12. Bed/tail of fresh epoxy formed to extend the length/width of a small fin (not yet added in this photo).

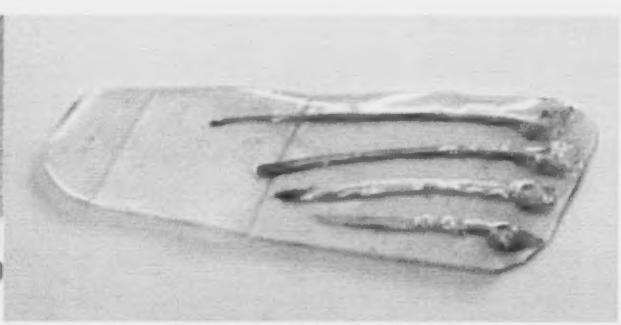


Figure 13. Separated individual fin-rays embedded in epoxy.

Figure 14. Small/short epoxied fin with 'tail' for extension.

2.3 SECTIONING FINS

When the SCL develops a fin method all fins (dorsal, ventral, pectoral and pelvic) are collected from each fish to establish the preferred fin and fin-rays for age determination. Fins and fin-rays that include all annual growth zones and exhibit the clearest growth patterns with contrasting opaque and translucent zones are chosen as standards for production ageing. Optimum section thickness is determined by cutting eight to ten sections of varying thicknesses (0.75 – 3.00mm) from each fin to identify which ones present the clearest pattern. Usually a range of section thicknesses are established as a standard. Table 1 lists section thickness ranges established for some species aged by the SCL. To provide consistency for ageing, the first fin section should always be taken from the same location near the fin base. This is important as the SCL uses annual growth zone measurements to help identify the first few years of growth for some species (Surry and King 2003). The number of sections cut depends on the species and to some degree the size of the fin, e.g. six to eight are preferred for lingcod and five for Pacific cod.

To improve operational efficiency and safety the SCL has made a number of modifications to the original Bronwill® bone sectioning machine:

- Removed the oil reservoir and attached hoses to deliver tap water to cool the blade and capture fin and epoxy dust.
- Attached a customized vacuum system to a large Plexiglas® hood which removes air or water-bound particles dispersed by the cutting wheel.
- Inserted a clear, protective face shield of Marguard® to protect eyes from debris.
- Removed the control panel from the machine and placed at table top level for ergonomic ease and protected it against water splash with a plastic shield.
- Added a wire safety-catch to the lever that clamps the fin into the chuck to keep it from springing back at the operator's face.

2.3.1. Equipment and Materials

- sectioning machine: e.g. modified Bronwill® TSM Universal Model 77 bone sectioning machine
- diamond saw blade (e.g. Norton® Diamond saw blade 4" X 0.015" X 0.500" 1/8" return)

- cloth net material and metal screen
- frosted glass slides (2.6 X 17.6cm)
- permanent ink pen
- slide drying boards & rack
- 19 – 20cm forceps
- compound microscope
- health & safety: refer to sectioning machine modifications list
- personal protection equipment: approved ear protection (e.g. earmuffs #LM-77 EN 352-1:1993 CE or earplugs), lab coat, fine particulate dust mask if dry sectioning non-epoxied fins (e.g. 3M 8210 Respirator N95 Particulate)

2.3.2. Procedure

2.3.2.1. Preparation of glass slides:

1. On the first slide, use a permanent ink pen to write all sample information: species abbreviation and fish number at the top followed with species name, first and last fish number in sample, vessel name, area and date caught, yyyy/mmm/dd (Fig.15). Add the fin type if more than one, e.g. dors=dorsal and pec=pectoral, is being sectioned for the same fish.
2. On subsequent slides write only the species abbreviation followed by the fish number (Fig. 15) at the top of the slide.
3. If more than one type of fin is processed in a sample, include fin type abbreviation on each slide, e.g. DF=dorsal fin, PF=pectoral fin. Return slides to the box, in numerical order.

Figure 15. SCL labelling conventions for glass slides used to mount fin sections. The first slide (top) must be labelled with all fish and sample information while subsequent slides (below) need only include fish species abbreviation and fish number ID.

2.3.2.2. Sectioning epoxied fins:

1. Locate and become familiar with all control switches and features on the sectioning machine (Fig. 16).
2. Ensure that the metal screen is properly placed in the saw reservoir bed and the cloth netting is positioned next to the chuck to prevent sections from washing down the drain hole (Fig 17).
3. Turn on the sectioning machine and set the fume hood exhaust to HIGH and turn on water to lubricate the saw blade.

4. Place a fin in the chuck and align the fin rays perpendicular to the blade so that the cut will be 90° to the fin-ray's long axis. A 90° angle cut is optimum producing the clearest patterns required for age determination.
5. The fin should also be positioned in the chuck to ensure the first cut will be close to the fin base and the blade radial axis approaches the fin at a 45° (Fig. 18a). At this angle, the blade will cut through only one or two of the rays at any given time. This reduces cutting surface minimizing resistance and friction. If the blade were to cut through all rays simultaneously (Fig. 18b), the increased resistance would cause the blade to push, rather than cut, through the fin producing an oblique cut with an unclear growth pattern that is difficult to age (Fig. 19). The saw blade can be raised and lowered by the wheel handle to maintain cutting angle.
6. Make the first cut at the very base of the fin-ray and place the end piece back into the fin envelope. Be careful not to cut too far up from the fin ray base to avoid cutting off the first year of growth.
7. Follow the recommended unit measurements for the species (Table 1) and move the blade into position for the second cut.
8. Remove the section and immediately rinse under water to remove epoxy and tissue residue from the surface and place on the pre-numbered glass slide with the last cut side facing up.
9. Using a compound microscope, periodically check the clarity of the growth pattern on the sections. Fin-rays tend to be slightly curved sometimes resulting in the need to adjust the cutting angle part way through sectioning. If the pattern remains clear continue. But if it is vague, check the ray to blade angle and if needed, re-adjust to a 90° angle.
10. Cut five to eight sections (depending on species and fin size) and place sequentially on the glass slide, last cut side up, to ensure consistent orientation. If the sections are large, use two slides per fin and add the labels (a) and (b) after fish number, e.g. first slide LC 23a and second slide LC 23b.
11. With each successive cut the blade is moved closer to the chuck. After a number of cuts it may be necessary to reposition the fin outward, further away from the chuck to avoid hitting the chuck with the saw blade or the flanges that hold the blade in place.
12. Place each slide and sections on a drying board in the rack (Fig. 20).
13. Remove the remaining fin piece from the chuck and return it to the envelope.
14. Follow the above procedure for all fins in the sample.
15. Allow the sections to dry overnight before applying the liquid cover slip.

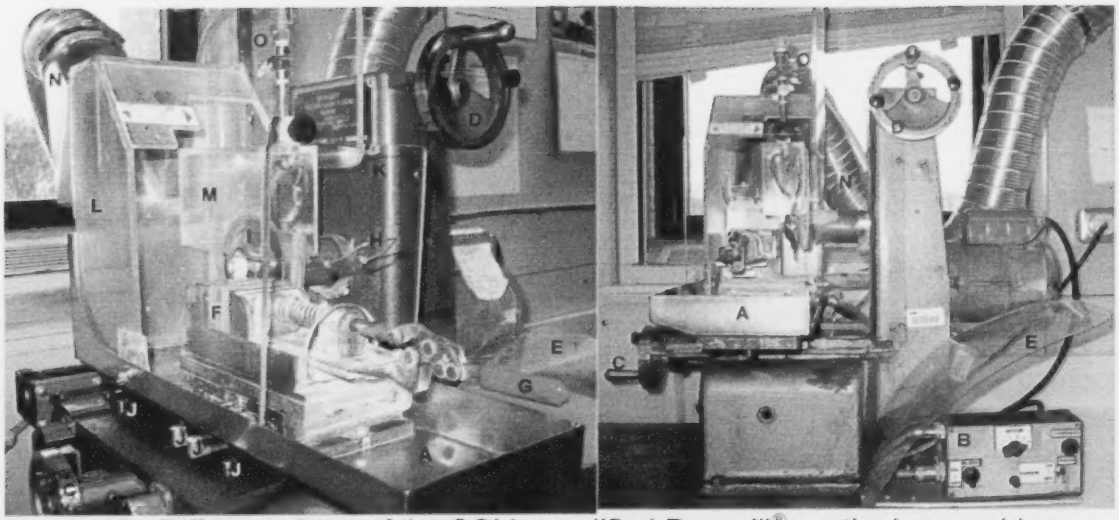


Figure 16. Different views of the SCL's modified Bronwill® sectioning machine with parts labelled. A-bed reservoir, B-control panel, C-cross-feed handle, D-control wheel for blade height, , E-flexible plastic water shield, F- chuck, G-green chuck lever, H-wire safety catch, I- saw blade, J-oil cups, K-marguard® face shield, L-plexiglass® hood, M- plexiglass® shield, N-exhaust system, O-water cooling system.

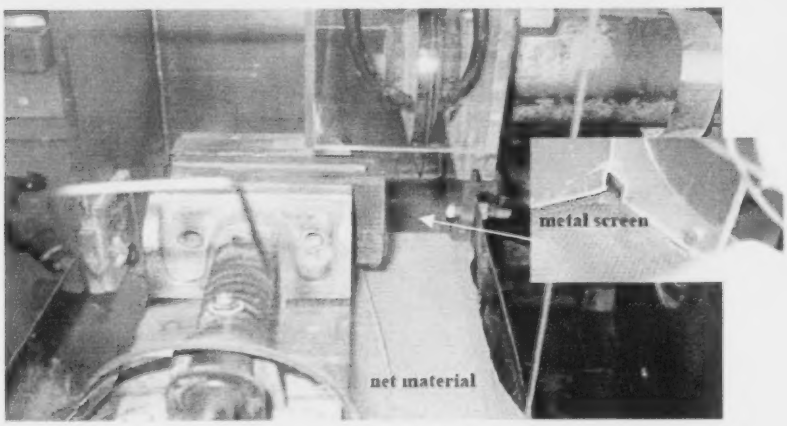


Figure 17. Close up of SCL's high speed saw showing the net material and metal screen needed to prevent sections from being sucked into the bed reservoir drain hole.

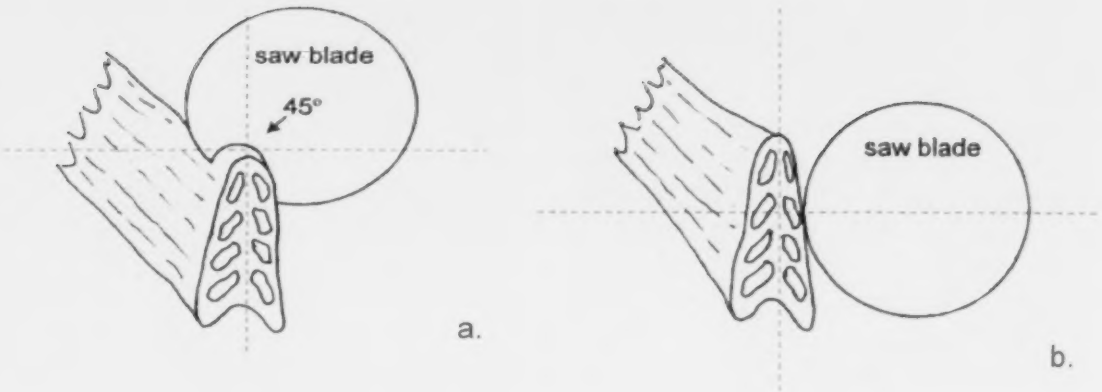


Figure 18. Illustration showing how the saw blade should and shouldn't approach the fin for effective sectioning. a) Correct position of fin and blade for cutting good quality fin sections with the blade cutting through the fin at a 45° angle. b) Incorrect position of saw blade which produces more friction causing the blade to push rather than cut through the fin resulting in oblique cut sections with blurred growth patterns.

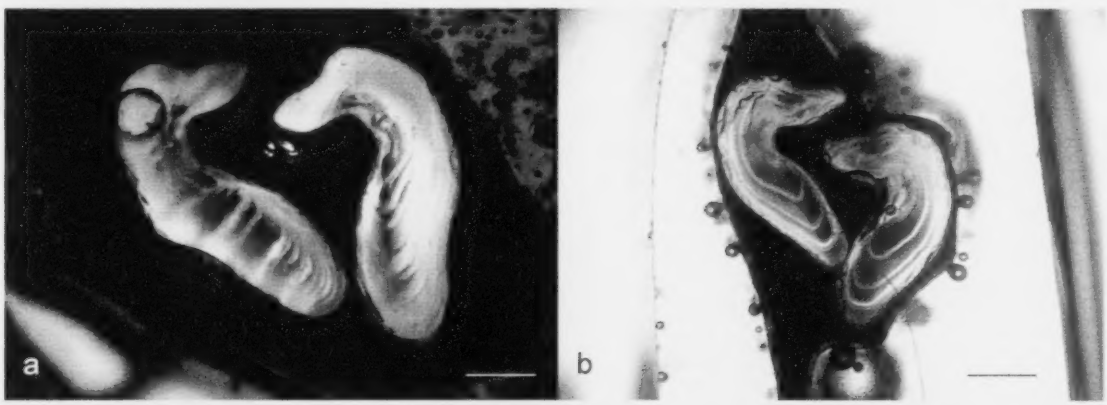


Figure 19. Photos of lingcod fin cross-sections illustrating a) an oblique cut section with poor growth pattern resolution and b) a good quality section with a clear annual pattern. Scale bar = 0.63mm.

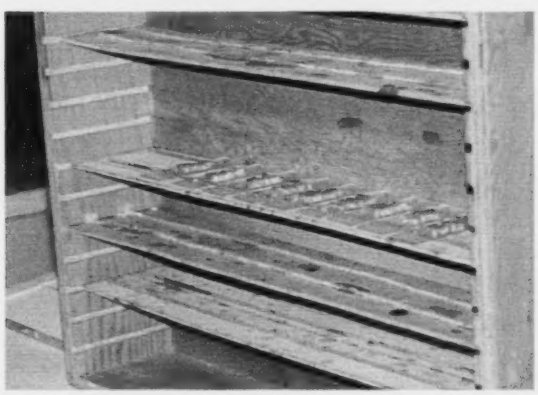


Figure 20. Slide drying boards in rack.

2.3.2.3. Sectioning non-epoxied dry fins:

Since water cannot be used to cool the blade a fine particulate dust mask must be worn at all times when sectioning non-epoxied fins. To section these fins, follow the same procedure outlined for sectioning epoxied fins but eliminate turning on the water in step 3.

2.4. MOUNTING FIN SECTIONS ONTO SLIDES

Fin sections must be mounted onto glass slides for viewing. A liquid cover slip is applied to all sections to improve the clarity of the growth pattern and to help preserve and secure them to the glass slide. If water has been used in the sectioning process, allow sections to dry overnight before applying the liquid cover slip. If water has not been used, the cover slip can be applied to the sections at any time.

2.4.1. Equipment and Materials

- probe
- liquid cover slip (e.g. Flotexx® #137703)
- health & safety: fume hood
- personal protection equipment: nitrile or latex gloves, lab coat

2.4.2. Procedure

1. Place the slide drying boards and rack into the fume hood and turn exhaust system to HIGH.
2. Remove the first board of slides from the drying rack and place inside the fume hood at a convenient distance for working and close the fume hood window to the recommended level.
3. Starting with the first slide use fingers to gently loosen the fin sections from the glass if they are stuck. This will allow the liquid cover slip to flow evenly under the sections to securely attach them to the slide when dry.
4. Place the sections close together on the slide so that when viewed during age determination, the annual pattern on each ray can be tracked from section to section. Be sure to maintain section sequence and orientation.
5. Place the first section to the right of the frosted label area and leave 0.5cm between the last fin section and the right edge of the glass slide (Fig. 21) to ensure that the glass slides will fit into slide box slots properly. Sections should not extend beyond the top, and especially the bottom, of the slide. Otherwise, the slides will not fit securely into slide box slots.
6. If water was used when sectioning, the fin sections may curl as they dry and must be flattened before the cover slip is applied. If necessary, use fingers to crack the surrounding epoxy, then straighten and flatten all sections.
7. Slowly drip the liquid cover slip from immediately above sections to reduce bubble production. Work on sections from one end of the slide to the other. Do not allow excess liquid to flow beyond the sections or off the glass slide.

8. Immediately check each section, especially the rays, for air bubbles in the liquid cover that can obscure the growth pattern. Quickly use a probe to break any bubbles before the liquid cover slip solidifies.
9. After completing the above for all slides on the drying board, return it to the rack.
10. Follow the above procedure for each board of slides in the sample, leaving them in the fume hood for at least 24 hours, or until the cover slip is completely hard. A fingernail should not make a mark when pressed into properly cured cover slip.
11. Store mounted fin sections in labelled slide boxes. Do not place slides into the slide box until the cover slip is completely hard or the sections may slip to the bottom of the slide box and stick.

Figure 21. Labelled slides showing placement of fin sections in sequential order, first section to the left. Arrows indicate 0.5cm minimum distances that sections can be from the right hand edge of the slide. Note that longer sections are angled to avoid overhang.

2.5. STORAGE OF FIN SECTION SLIDES

Fin section slides should be stored in properly labelled slide boxes to keep samples organized and prevent the slides from breaking.

2.5.1. Equipment and Materials

- slide boxes
- permanent ink pen

2.5.2. Procedure

1. Use a permanent ink pen to label the front of each slide box with all sample information.
2. Place the slides into the box in numerical order.
3. Store envelopes of unused fin portions in a bag and label with all sample information. Fin ends (stubs) may be used if the initial sections are poor and more sections are required.

2.6. SECTIONING MACHINE MAINTENANCE

It is important to carry out regular maintenance to keep machinery in good working order to avoid breakdowns that might otherwise cause delays in meeting deadlines. The following describes the maintenance specific to the Bronwill® sectioning machine used by the SCL.

1. Clean all surrounding Plexiglas® and Marguard® after completing a sample or each day of use: Detach and clean the main Plexiglas® hood, blade shield and the Marguard® face shield (Fig. 16) with a soft cloth or soft paper towel and warm soapy water.
2. Remove and wash the net material and the metal screen from inside the machine bed (Fig. 17). Clean inside the machine bed and the chuck. Check that the drain pipe is clear.
3. After eight hours of machine use, add a few drops of oil to the six oil cups. Four are located on the left of the bed (Fig. 16 - J) and two on the right side of the bed.

ACKNOWLEDGEMENTS

The authors would like to express their thanks and appreciation to Darlene Gillespie and Audrey Ty for their editorial suggestions and Henrik Kreiberg who kindly reviewed the manual.

GLOSSARY

Tail/epoxy tail: Extra epoxy, called a tail, is added to short, small or damaged fins to increase their length. This ensures that the fin protrudes far enough from the chuck to prevent collision with the saw blade and its flange.

Epoxy bed: A rectangle of epoxy formed to embed short or separated fin rays to facilitate the sectioning process.

Chuck: Vice for gripping fins during sectioning.

Compound scope: High magnification microscope with transmitted light.

Distal: Situated furthest from the body centre or point of attachment.

Dorsal: Located on the back of the fish.

Fin-ray elements: Each fin-ray is made up of two bony elements.

Fin-ray or ray: The fins of bony fish are composed of many rays.

Fin-ray base: The fin-ray base is where the fin-ray elements attach to the backbone or other supportive bones. The base must be conserved during sampling and trimming.

Liquid cover slip: Liquid plastic used to fasten sections onto glass slides that acts as a cover slip to enhance the clarity of the section growth pattern when viewed with a microscope.

Preferred fin(s) and preferred rays: The SCL has established specific fins and rays to be collected for production ageing purposes. They generally provide the clearest and most consistent and complete growth pattern for age determination.

Production ageing: Age determination of large numbers of commercially important species for stock assessments.

Sclerochronology: The study of physical and chemical variations in the hard tissues of organisms and the temporal context in which they are formed.

Viscous: Fluids that have a glutinous quality that will maintain shape or form rather than being runny.

REFERENCES

Beamish, R.J., and Chilton, D.E. 1977. Age determination of lingcod (*Ophiodon elongates*) using dorsal fin-rays and scales. J. Fish. Res. Board Can. 34: 1305-1313.

Beamish, R.J. 1981. Use of fin-ray sections to age walleye pollock, Pacific cod, and albacore, and the importance of this method. Trans. Am. Fish. Soc. 110: 287-299.

Chilton, D.E. and R.J. Beamish. 1982. Age determination methods for fishes studied by the Groundfish Program at the Pacific Biological Station. Can. Spec. Pub. Fish. Aquat. Sci. 60: 102 p.

Chilton, D.E., and Bilton, H.T. 1986. New method for ageing Chinook salmon (*Oncorhynchus tshawytscha*) using dorsal fin rays, and evidence of its validity. Can. J. Fish. Aquat. Sci. 43, (8): 1598-1594.

Ferreira, C.G., Beamish, R.J., and Youson, J.H. 1999. Macroscopic structure of the fin-rays and their annuli in pectoral and pelvic fins of chinook salmon, *Oncorhynchus tshawytscha*. J. Morphology 239:297-320.

MacLellan, S.E. 2004. Guide for sampling structures used in age determination of Pacific salmon. Fisheries and Oceans Canada, Stock Assessment Branch, Pacific Biological Station, Nanaimo, BC. 26 page pamphlet.

McFarlane G.A., and King, J.R. 2001. The validity of the fin-ray method of age determination for lingcod (*Ophiodon elongates*). Fish. Bull. 99: 459-464.

Mills, K.H., and Beamish, R.J. 1980. Comparison of fin-ray and scale age determinations for lake whitefish (*Coregonus clupeaformis*) and their implications for estimates of growth and annual survival. Can. J. Fish. Aquat. Sci. 37 (3): 534-544.

Surry, A.M ,and King, J.R. 2003. Diameter measurements for identification of the first and second annulus on dorsal fin ray sections from lingcod (*Ophiodon elongatus*). Can. Tech. Rep. Fish. Aquat. Sci. 2490: 24p.